Properties and Classifications of Matter

PS-3 The student will demonstrate an understanding of various properties and classifications of matter.

PS-3.4 Classify matter as a pure substance (either an element or a compound) or as a mixture (either homogeneous or heterogeneous) on the basis of its structure and/or composition.

Taxonomy Level: 2.3-B Understand Conceptual Knowledge

Key Concepts:
Pure substance: Element, Compound
Mixture: Homogenous mixture, Heterogeneous mixture

Previous/Future knowledge: In 7th grade (7-5.2), students classify matter as element, compound, or mixture on the basis of composition.
In Physical Science (PS-2.1), students developed and understanding of elements as composed of only one type of atom. (PS-3.3) added that molecular substances are composed of two or more types of atoms that are bonded together as molecules and that molecular substances do not retain the properties of their components but have their own identifying properties (PS-3.3).
This indicator lays the foundation for an understanding of chemical reactions (PS-4.8).

It is essential for students to

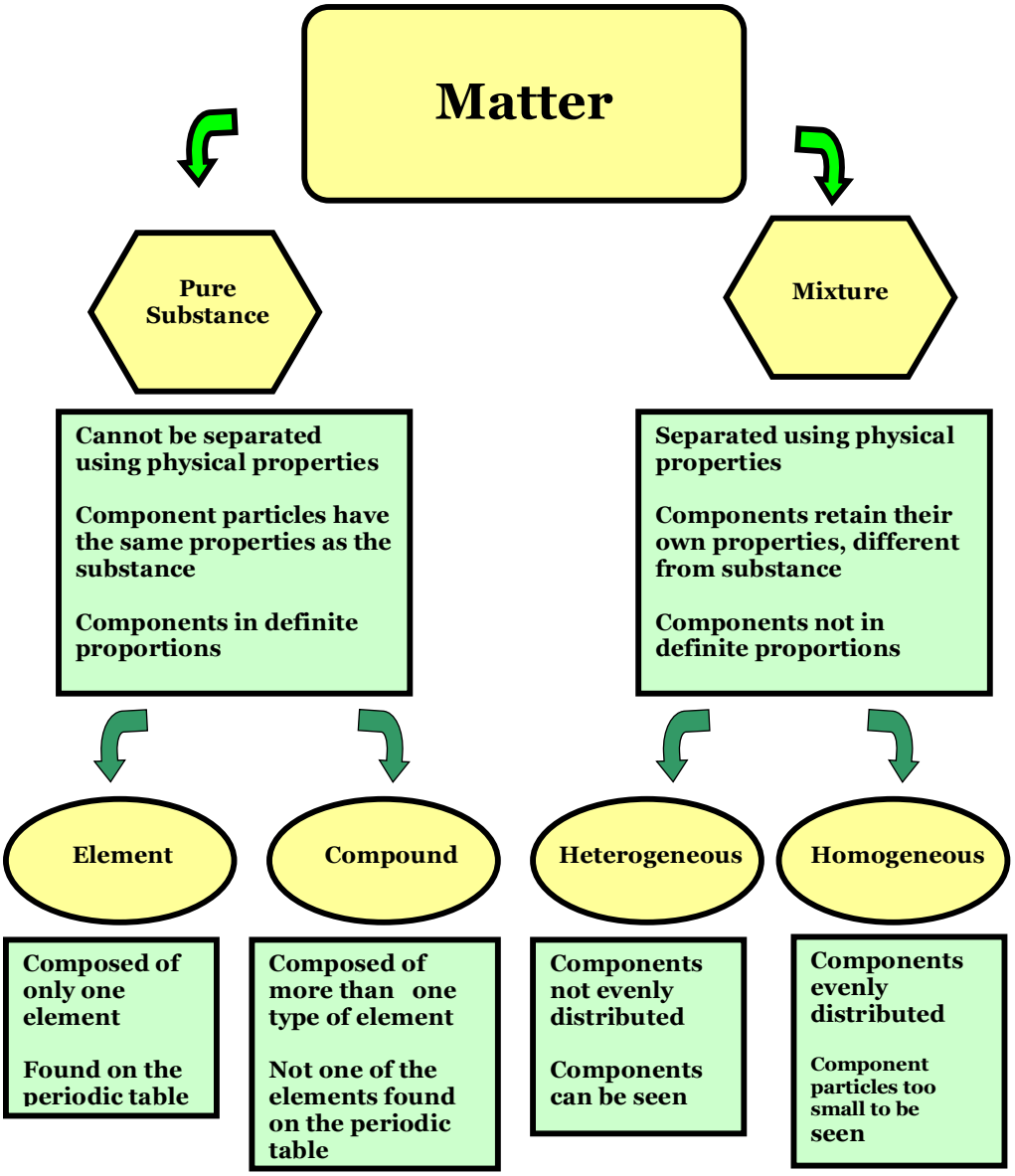
- Understand that substances that have unique, identifying properties are called *pure substances*. There are two types of pure substances, elements and compounds.
  - An *element* is a pure substance which is composed of only one type of atom. All of the elements are listed on the periodic table
  - A *compound* is a pure substance which is composed of more than one type of element.
    - Compounds all have identifying properties which are different from the properties of the elements which compose them.
    - Compounds can be decomposed into elements only by chemical reactions; they can not be separated into elements by physical means.
    - Compounds have a definite chemical composition identified by a chemical formula. For example, the ratio of the number of oxygen atoms to hydrogen atoms in any sample of water is always 1 to 2.
    - Molecular substances are one type of compound, and ionic substances are another type of compound (this is addressed further in PS-4.1 through PS-4.5).
- Understand that when matter is composed of two or more component substances which retain their own identifying properties, the matter is classified as a *mixture.*
  - A mixture can be separated physically because the components of the mixture have different physical properties. (PS-3.1) Examples of procedures for separating mixtures based on differing properties include but are not limited to:

• Dissolving	• Filtering	• Evaporating
• Decanting	• Magnetic separation	• Chromatography
• Separating by particle size (screening)		

- Mixtures do not have definite composition; the components of a mixture may be in any ratio.
- Mixtures can be classified into two groups, heterogeneous and homogeneous.
  - *Heterogeneous mixtures* do not have the components distributed evenly throughout. The different components are often easy to see in a heterogeneous mixture.

  - *Homogeneous mixtures* have components evenly distributed all the way down to the particles, whether atoms, molecules, or ions. The components are so small that they can not be seen with the naked eye. A *solution* is a homogeneous mixture. (Ions will be addressed in PS-4.2.)
- Understand that mixtures can occur between and among all phases of matter:
  - Gas/gas (air)
  - Gas/liquid (oxygen in water)
  - Liquid/liquid (alcohol in water)
  - Solid/liquid (sugar in water)
  - Solid/solid (alloy such as steel)

The following graphic organizer is a way for students to organize their thinking.



Properties and Classifications of Matter

PS-3 The student will demonstrate an understanding of various properties and classifications of matter.

It is not essential for students to

- Understand colloids or suspensions;
- Understand colligative properties.

Assessment Guidelines:

The objective of this indicator is to *classify* matter as a pure substance or a mixture, therefore, the primary focus of assessment is to group pure substances or mixtures on the basis of the criteria for each category, and to further group pure substances as an element or a compound, and mixtures as a homogeneous or a heterogeneous mixture.

In addition to *classify*, assessments may require that students

- *Exemplify* a pure substance, mixture, element, compound, heterogeneous mixture, homogeneous mixture/solution, and justify the example;
- *Compare* one of the given categories to another as to relevant characteristics which define each category;
- *Summarize* the major points which define each category.